

[54] STRIP FILM PROJECTOR

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[52] U.S. Cl. ....242/71.2, 353/95  
[51] Int. Cl. ....G03b 23/02, G03b 21/00  
[58] Field of Search.....242/71.2, 194, 197, 199, 200, 242/201, 210

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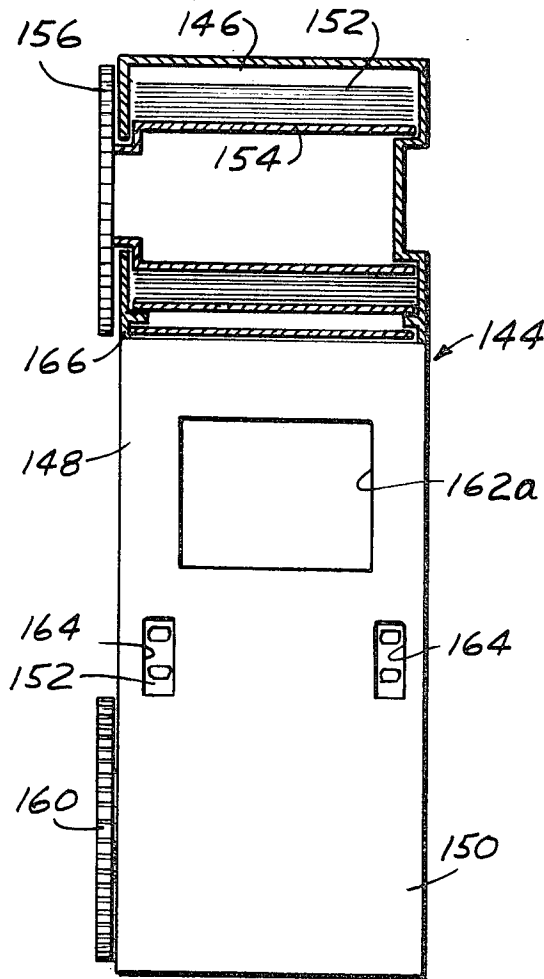
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[57] ABSTRACT

A compact lightweight strip film projector in which the strip of still pictures is carried in a magazine attachable to and detachable from the projector, and in which the film is rewound into its initial condition upon completion of projection by means of a power train driven by a motor in the projector. A film metering sprocket ends the rewinding step by stopping the motor after all film has been rewound. Projection is frame-by-frame and is accomplished manually or remotely through the action of the motor.

1 Claims, 14 Drawing Figures



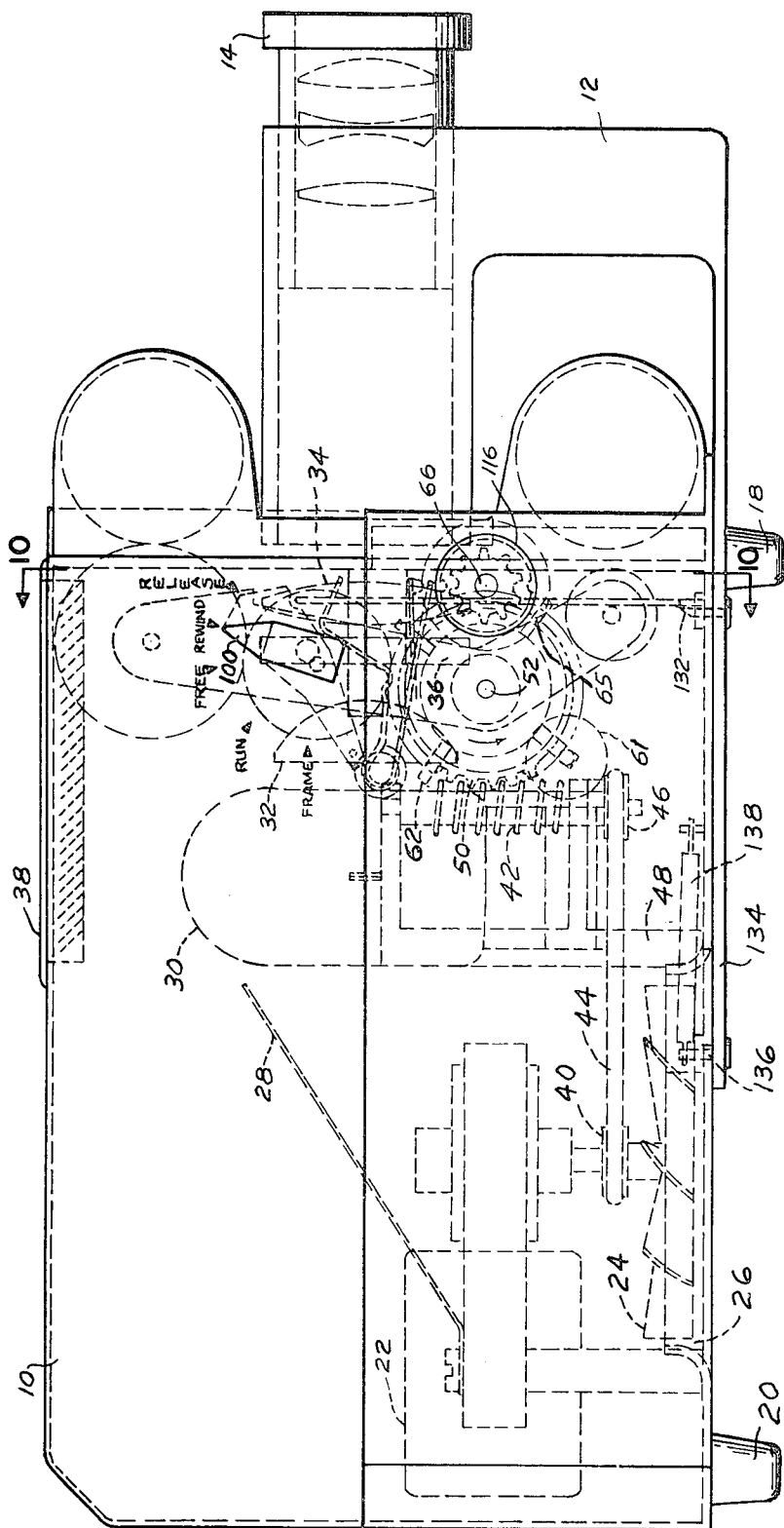


FIG. 1

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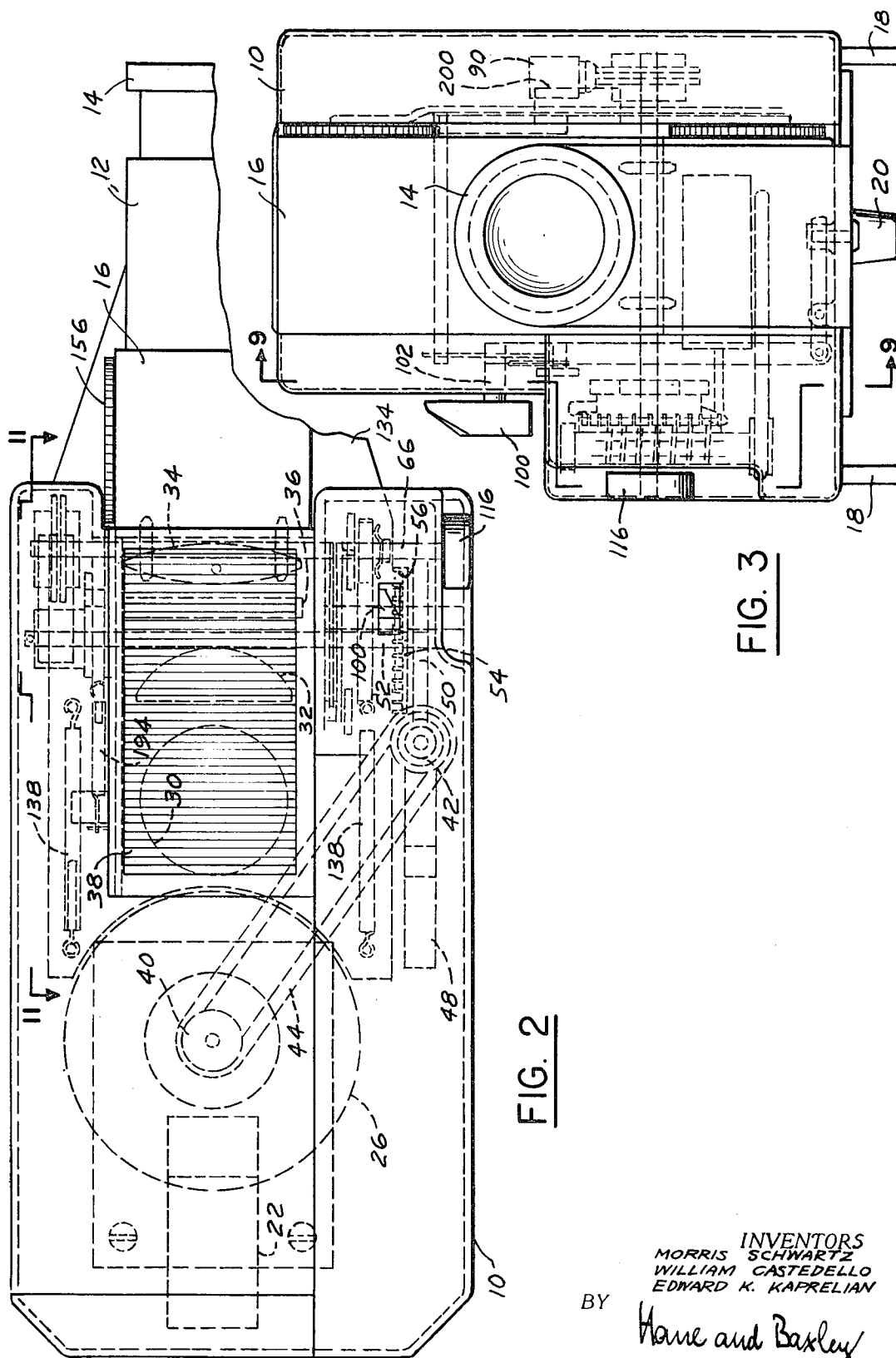


FIG. 3

FIG. 2

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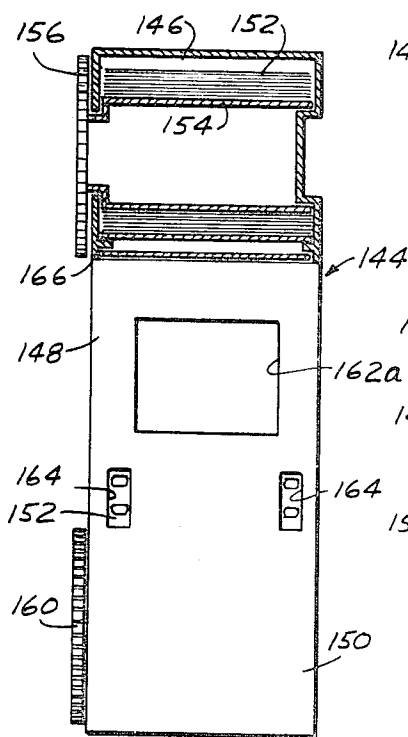


FIG. 7

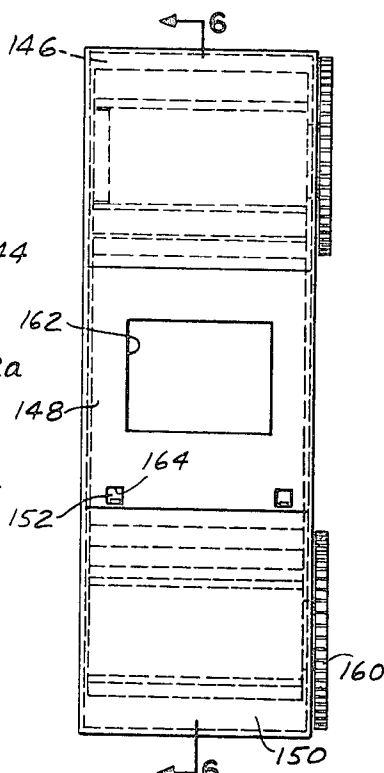


FIG. 4

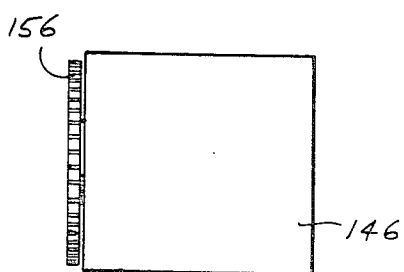


FIG. 8

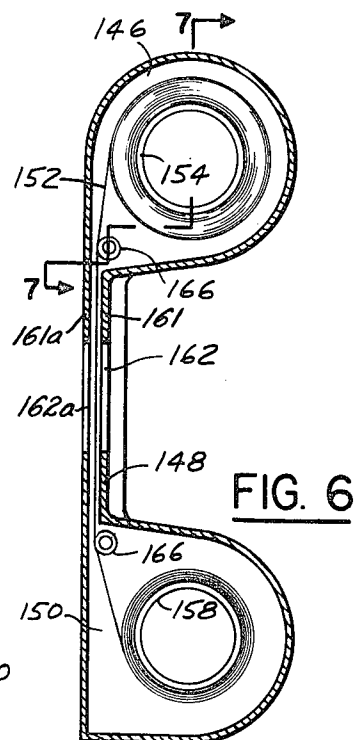


FIG. 6

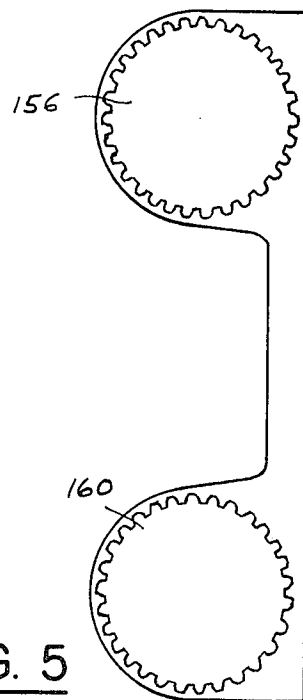


FIG. 5

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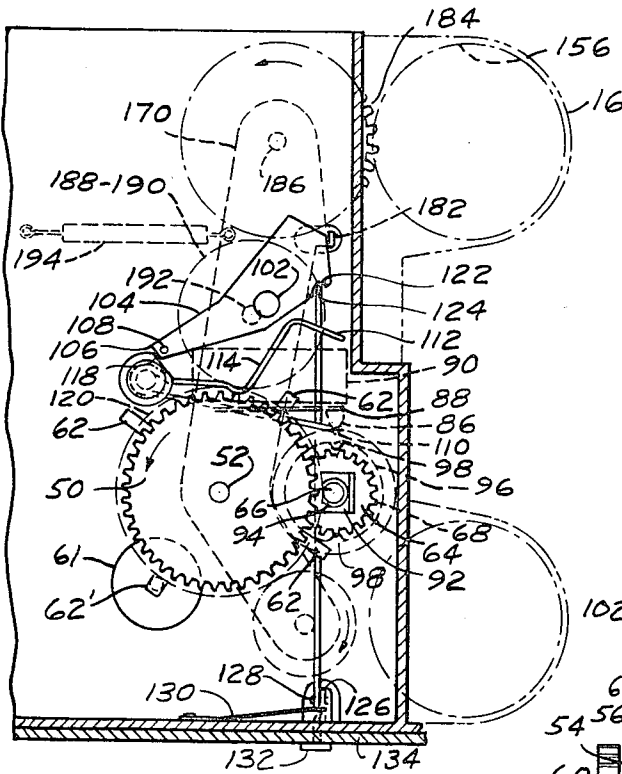


FIG. 9

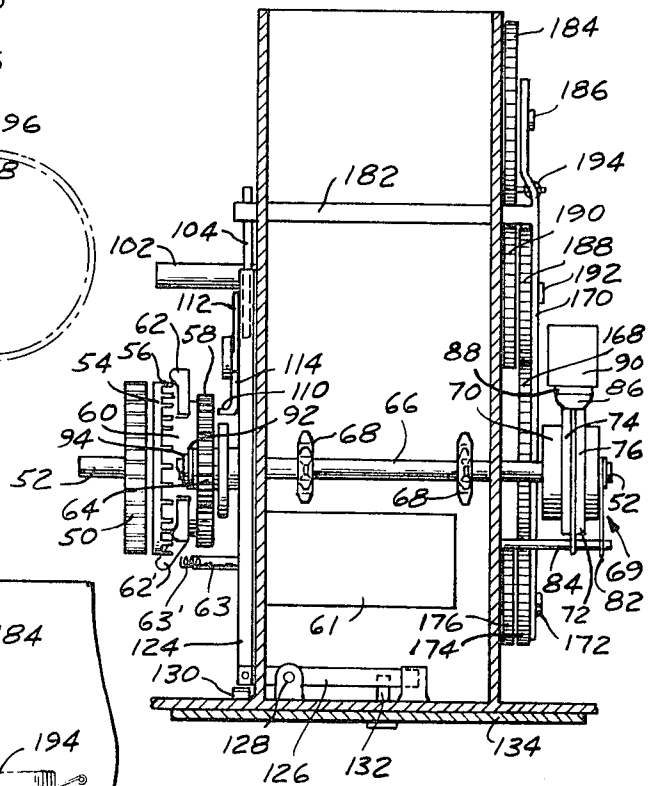


FIG. 10

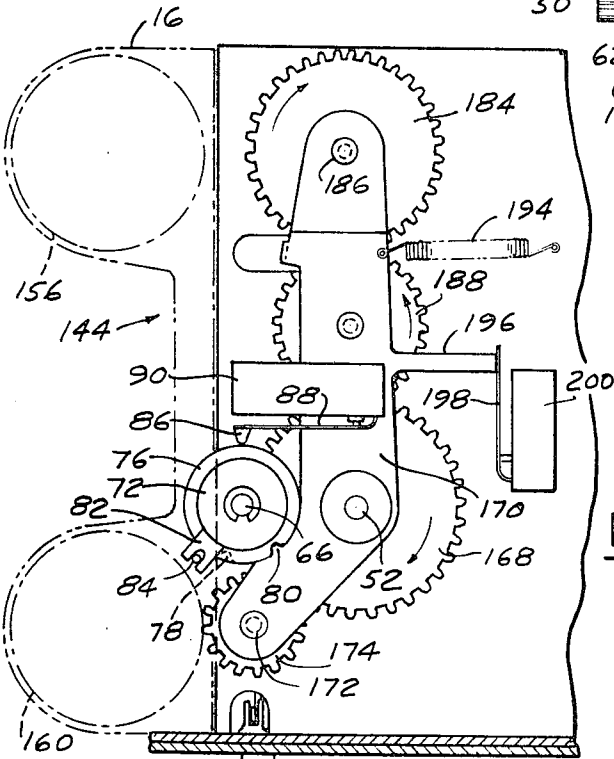


FIG. 11

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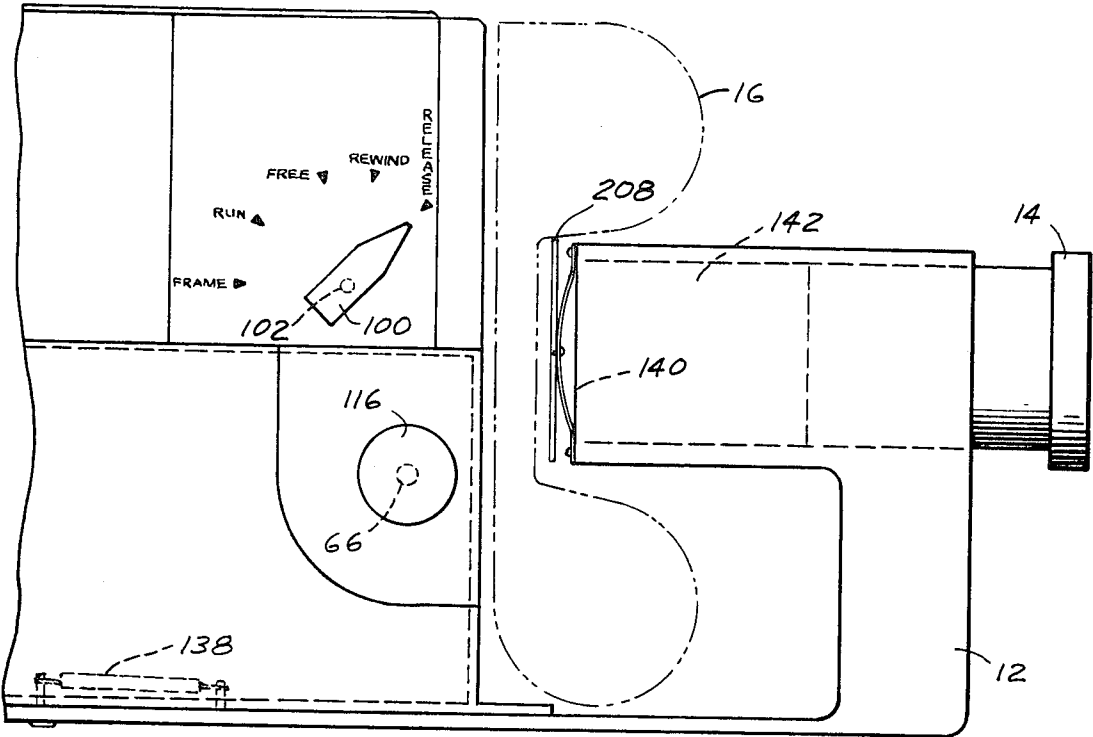


FIG. 12

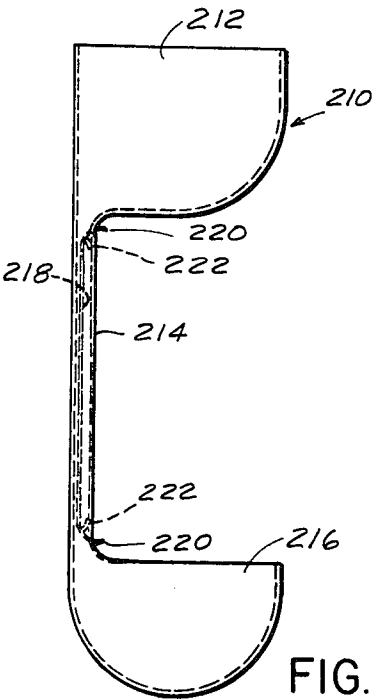


FIG. 13

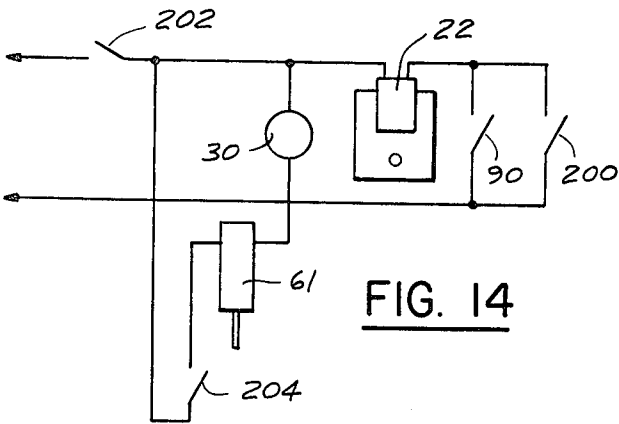


FIG. 14

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## STRIP FILM PROJECTOR

This invention relates to an improved strip film projector and is concerned with visual presentation of successive picture frames on a strip of film. Projectors according to the invention are equally useful for training, teaching, advertising or home entertainment.

One of the objects of the invention is to provide a compact, lightweight projector employing a film magazine.

Another object is to provide means for advancing the film frame-by-frame in the magazine by means of a motor driven film drive mechanism.

Still another object is to rewind the film in the magazine after all or part of it has been projected by means of the film driving motor.

Still another object is to end the rewinding step after the film has been restored to its initial condition in the magazine.

Still another object is to provide the capability of either remote or manual operation to effect rapid and automatic frame change.

It is also an object of the invention to provide a novel and improved strip film magazine which is compact and inexpensive and which has the capability of winding the film from a supply spool to a takeup spool and vice versa.

These and other objects and advantages will become more fully apparent from the specification and the drawing in which:

FIG. 1 is a side view of the projector with the strip film magazine in operating position;

FIG. 2 is a top view of the projector with the strip film magazine in operating position;

FIG. 3 is a front view of the projector with the strip film magazine in operating position;

FIG. 4 is a front view of the strip film magazine;

FIG. 5 shows the side of the magazine as seen from the right side of FIG. 4;

FIG. 6 is a sectional view of FIG. 4 along lines 6—6;

FIG. 7 is a rear view of the magazine partially sectioned along lines 7—7 of FIG. 6;

FIG. 8 is a top view of the magazine;

FIG. 9 is a sectional view of part of the projector along lines 9—9 of FIG. 3;

FIG. 10 is a sectional view of part of the projector along lines 10—10 of FIG. 1;

FIG. 11 is a sectional view of part of the projector along lines 11—11 of FIG. 2;

FIG. 12 is a view of the projector along the lens carrier in forward position;

FIG. 13 is a view of a holder for employing rolls of strip film in the projector; and

FIG. 14 is the electrical circuit diagram of the projector.

As shown in FIG. 1, the projector comprises generally a main body portion or housing 10, a slidable lens carrier 12, a projection lens 14 and a removable film magazine 16. The projector body is supported on a pair of front feet 18 and a rear foot 20 which are preferably adjustable to permit appropriate positioning of the projector relative to a screen. The means for adjustment, not shown, may be similar to that disclosed in copending application Ser. No. 659,966, filed Aug. 11, 1967.

Contained within the housing is a motor 22 driving a cooling fan 24 which draws air through an opening 26 in the bottom of the housing. The air is directed by a deflector 28 against a lamp 30, condenser lenses 32 and 34, and a heat filter 36. The air is vented through a removable grill 38 at the top of the projector body which also provides access to the lamp and to the condenser lens assembly for replacement and cleaning procedures respectively.

The shaft of motor 22 carries a pulley 40 which drives a worm 42 through a belt 44 and a pulley 46. Worm 42, which is supported by a bracket 48 attached to the bottom wall of the projector, engages a gear 50 which rotates freely about a shaft 52 and which in turn is connected to and drives a ratchet plate 54 provided with teeth 56 which are turned in the manner

of a crown gear, as best shown in FIGS. 9 and 10. This construction and the description of the film advance means which follows are substantially the same as that described and shown in the aforementioned copending application Ser. No. 659,966. Attached to shaft 52 and rotating therewith is also a gear 58 to which is attached a pawl assembly 60 which comprises a cylindrical portion provided with four slots carrying pawls 62 and 62' (FIGS. 9 and 10). The inner ends of the pawls are restrained frictionally by a spring plate while permitting the ends of the pawls to be moved in a plane passing through shaft 52. In normal, nonfilm-advancing condition, the pawls are out of engagement with gear 50 or plate 54 as shown in FIG. 10. Positioned so as to coact with the pawls 62 and 62' is a solenoid 61 the plunger 63 of which is tipped with a piece of coil spring 63'. At 90° in a counterclockwise direction from plunger 63 is a restoring cam 65 (FIG. 1) which is provided with a portion which engages the end of one of the pawls 62 and 62' pushed outwardly by plunger 63 of solenoid 61 into engaging relationship with teeth 65 of ratchet plate 54 as in the case of pawl 62' of FIG. 10, and restores the pushed-out pawl to its free or nonengaged position as is shown for pawl 62 in FIG. 10.

Gear 58 engages a gear 64 which is carried by a shaft 66 which in turn drives a pair of film-advancing and film-metering sprockets 68. Carried on the opposite end of shaft 66 is a conventional dial counter assembly 69, such as is employed in odometers, comprising a pair of counter wheels 70 and 72. Counter wheels 70 and 72 carry cam plates 74 and 76 respectively, which in turn are provided with notches 78 and 80 respectively (see FIG. 11). Gear plates 82 of the counter are held against rotation by a pin 84. Cam plates 74 and 76 and notches 78 and 80 cooperate with a follower 86 on the free end of an arm 88 which actuates a switch 90, the function of which will be described. Switch 90 is attached to the sidewall of the projector by means of a bracket arm, not shown.

Gear 64 is axially urged by a spring 92 against a washer 94 and a cam plate 96, the latter being attached to shaft 66 and provided with a pair of notches 98 which are displaced by 180° from each other. Gear 64 has half the number of teeth carried by gear 58 and, hence, makes two turns to each turn of gear 58.

Control over the modes of operation of the projector is achieved by means of a knob 100 on a selector shaft 102 which carries a plate 104 having its protruding end 106 squared off and mounting a pin 108. When shaft 102 and plate 104 are in their extreme counterclockwise portion, pin 108 engages a right angle bend at the top of a spring 114 whereby ends 110 and 112 of the spring are forced into one of notches 98 on plate 96, thereby locking cam plate 96 and gear 64 in fixed positions. When the shaft 66 is in this mode it is possible to reframe a picture in the projector gate by rotating a knob 116 which is secured on shaft 66 and thus in turn rotates the shaft and sprockets 68.

For normal running operation, selector shaft 102 is rotated clockwise to a position somewhat displaced from the aforesaid fully counterclockwise position to one in which pin 108 on plate 104 engages the center portion of the upper part of spring 114, forcing only end 110 thereof into notch 98. This action properly positions each successive frame in the gate, spring 114 being sufficiently compliant in this setting to overcome its action by the driving torque exerted on shaft 66 when a frame change is desired in a manner to be described.

It is also possible to position shaft 102 and plate 104 in an intermediate setting in which sprocket 68, shaft 66 and gear 64 are free wheeling. This occurs when a square end 106 of plate 104 engages a flat portion 118 in a spring 114 supporting cam 120 which in turn rotates counterclockwise and lifts end 110 of the spring out of notch 98 as shown in FIG. 9. In this position the sprocket mechanism can be freed for any desired reason, including for the purpose of pulling film quickly through the projector when the film is being fed from a roll held in a holder 210 shown in FIG. 13 rather than from magazine 16. Up to this point the actions of plate 104, pin

108, flat portion 118, spring ends 112 and 110 and notches 98 are analogous to those of the corresponding parts in aforementioned copending application Ser. No. 659,966.

By rotating shaft 102 and plate 104 even further clockwise, the sprocket mechanism assumes the position shown in FIG. 9 to rewind the film in magazine 16, while in the extreme clockwise position the lens carrier and the magazine are released, both in a manner to be described.

Initially, the lens carrier is released by rotating knob 100 to its extreme clockwise position which results in a notch 122 of plate 104 engaging a plunger 124 and forcing the plunger downward thereby causing a lever arm 126, which is pivoted on a pin 128 and normally urged into clockwise direction by a spring 130, to rotate in a counterclockwise direction to be lifted clear of a pin 132. The latter is connected to a slide plate portion 134 of lens carrier 12. Plate 134 is restrained in sliding relationship in reference to the base of the projector in a plane parallel to the lens axis by suitable guide pins 136 attached to plate 134 and sliding in slots in the bottom surfaces of the projector body. Springs 138 urge plate 134 and the lens carrier 12 into the open position shown in FIG. 12. After either the magazine or the film holder, as desired, is placed in position at the gate, the lens carrier is manually returned to the closed position as in FIG. 1 which results in arm 126 being lifted over pin 132 and latched in position. When so locked, the spring urged end 140 of lens barrel 142 forces the magazine or the film holder into its proper plane at the front of the projector body.

The film magazine (FIGS. 4 to 7) comprises a main body portion 144 which is preferably made in two separate pieces of a suitable plastic material and preferably arranged to be snapped together, although the parts may be cemented together if desired. The magazine comprises an upper or supply chamber 146, a central film gate portion 148 and a lower or takeup chamber 150. A film strip 152 is initially wound on and attached at its inner end to a spool 154 which is rotatably constrained in the supply chamber 146 in the manner shown and which carries a gear 156 at one end preferably made integrally with spool 154 and extending out of the magazine body as shown in FIG. 5. The film passes through a gate portion which is formed by walls 161 and 161a between the back surface of the magazine, the leading end of the film being attached to a lower spool 158 which is provided with an integral gear 160 and is correspondingly rotatably constrained within the lower or takeup chamber.

The gate portion of the magazine is provided with a frame openings 162 and 162a which correspond in size to that of the picture to be projected and are usually  $\frac{3}{4}$  inch by 1 inch for ordinary film strip, although obviously all dimensions of the magazine and the projector can be altered to accommodate larger or smaller picture sizes on both wider and narrower films. If desired, the frame openings may be covered by glass plates to retain the film in a flat plane and to prevent buckling of the film from the heat of the projection lamp.

The magazine is also provided with a pair of openings 164 to permit engagement of sprockets 68 with the perforations in the film. A pair of rollers 166 are positioned to correctly guide the film into the space within the gate portion so as to avoid scratching the film surfaces.

With the magazine in position and knob 100 in "run" position, gear 160 of lower spool 158 is engaged by a drive train actuated by motor 22. This coupling is achieved through gear 50 and shaft 52 which in turn rotate a main gear 168 attached to shaft 52. Floating on shaft 52 is a gear-carrying frame 170 which carries at its lower end on a bearing pin 172 a gear 174 in mesh with and driven by gear 168. Gear 174 is in spring-pressed frictional engagement with an identical gear 176 on pin 172. Gear 176 engages gear 160 in takeup chamber 150 and drives the lower spool when the gear carrying frame 170 is in the position shown in FIG. 11. It is clear from this arrangement that, as in the well known example of motion picture projectors, a takeup torque is constantly applied to the lower spool to take up slack without stressing or tearing the film, or the film perforations.

To use the projector, a main switch 202, FIG. 14, is closed whereby lamp 30 lights and motor 22 is energized. By closing a frame advance switch 294 which may be located at or remotely of the projector, solenoid 61 is energized. When this occurs, plunger 63 pushes pawl 62' into engagement with teeth 56 of ratchet plate 54, as shown in FIGS. 9 and 10, with the result that gear 50 and plate 54 rotate the pawl assembly and gear 58 in counterclockwise direction. As pawl 62' completes a 90° counterclockwise rotation, it is moved out of engagement with teeth 56 by restoring cam 65. Spring end 110 thereupon engages notch 98 insuring that gear 64 and sprockets 68 have rotated 180° and that the film 152 engaged by the latter has been advanced by one frame. This action is repeated until any part or all of the film in the magazine has been projected. Plunger 63, being tipped with the tightly coiled extension spring 63' is axially rigid but yieldable lateral so that continual energization of solenoid 61 during the advance cycle will not result in damage to the plunger by an oncoming pawl.

As the film is advanced, frame-by-frame, counter wheels 70 and 72 rotate. Wheel 70 may be a 10 counting wheel which makes one rotation for each 10 turns of sprockets 68, or one turn for each 20 frames. Wheel 72 may be a hundred counting wheel which makes one rotation for each 10 turns of wheel 70. Thus, these two wheels have a total count of 200 frames. If more than 200 frames are to be employed in the magazine, three or more counting wheels may be employed. Initially, wheels 70 and 72 are in their zero-zero position with notches 78 and 80 on cam plates 74 and 76 respectively, in line below follower 86. After the first frame has passed through the gate, wheel 70 has rotated one-twentieth of a turn, notch 78 has moved from under follower 86 and switch 90 is open. Continuity of the circuit is maintained by a switch 200 as shown in FIG. 14, to this end, a finger 196 (FIG. 11) on frame 170 being urged against an arm 198 to close switch 200 when knob 100 is in any one of the "frame," "run" or "free" positions. At the end of the film or at any stopping point, wheels 70 and 72 have counted the number of frames shown and have correspondingly rotated cam plates 74 and 76.

After the film has been shown and is on the lower spool, knob 100 is rotated to the "rewind" position. As a result, plate 104 rotates clockwise to the position shown in FIG. 9 and moves the end of an arm 182 to the right, overcoming a spring 194 and rotating frame 170 until a gear 184 carried on a pin 196 is in engagement with upper gear 156 of the magazine. Gear 184 is driven from gear 168 by means of a pair of frictionally coacting gears 188 and 190 urged together by a spring and separated by a friction washer, both not shown, carried on a pin 192. Motor 22 acting through the gear train rewinds the film onto upper spool 154. Because of the frictional connection between gears 188 and 190 the driving torque of the gear train is kept to a safe maximum to avoid tearing perforations or otherwise damaging the film in the same manner that the frictional connection between gears 174 and 176 prevents excessive pull on the film during transport in the projection cycle.

Following rewinding, knob 100 is turned to "release" position and the lens carrier 12 moves to its forward position thereby permitting the magazine to be removed. As shown in FIG. 12, the rear end of the lens barrel is provided with a spring pressed plate 208 which in normal projecting position maintains the magazine or holder in correct engagement with the front of the projector.

After the film is fully rewound on the upper spool, the projector motor is turned off by switch 90 coacting with notches 78 and 80 on cam plates 74 and 76 respectively, through follower 86. It should be noted that when a magazine is first inserted into the projector, the counter reads 0-0 and the notches 78 and 80 are in line immediately below follower 86. Accordingly, follower 86 is in its downwardmost position in the notches and switch 90 is open. Assuming that knob 100 is in any one of the "frame," "run" or "free" positions, finger 196 on frame 170 is urged against arm 198 on switch 200, closing the latter and thus energizing the circuit to the motor as shown in FIG. 14.



As the film is rewound on the upper spool, sprocket 68 and wheels 70 and 72 rotate in the direction opposite to that during projection. As a result, wheels 70 and 72 now subtract the count stored during projection and when the film is fully wound on the upper spool, that is, when the frame first projected is in its initial position, counter wheels 70 and 72 are in their zero-zero position, and switch 90 which during rewind has been in its uppermost, closed position, is now opened, thereby stopping the projector motor.

If desired, ordinary rolls of filmstrip may be employed in the projector through use of a holder 210 (FIG. 13). Although some of the advantages of the magazine are lost when such holder is used, the latter is convenient and requires no special preparation or handling of conventional filmstrip. Holder 210 comprises an upper film receiving chamber 212, a gate portion shown generally at 214 and a lower film receiving chamber 216. It may be constructed of sheet metal or of suitable plastic material, as desired, and has substantially the same lateral configuration as the magazine, but without the gears and spools. Upper chamber 212 receives the roll of film to be shown. The leading end of the film is passed through the gate portion and into the receiving chamber 216. The gate portion includes the same frame opening and sprocket openings as are provided for the magazine and has, in addition, a pressure plate 218 which is held captive by ears 220 passing through slots in the front wall of the gate portion 214. Suitable spring action, such as provided by fingers 222, or by other well-known means, urges the pressure plate against the back wall of the gate portion thereby holding the film in a flat plane or in a slightly curved plane concave to the lens, as desired. As in the case of the magazine, glass pressure plates may be used in the gate to confine the film, particularly in those applications where the use of large wattage lamps may result in film buckling.

The projector described obviously lends itself to numerous modifications depending upon the requirements and circumstances of use. As an example, the setting of frame 170 into required position is readily accomplished by a solenoid rather

than through mechanical action against arm 182. In this case, plate 104 would close a switch, when moved to rewind position, to close the circuit to the frame-actuating solenoid. In addition, the projector may be modified to operate in a completely automatic rewind mode through the inclusion of a switch and a switch arm, the latter projecting out of the projector housing and through an opening in the back surface of the magazine and resting against the film at an area near the sprockets. The film is then provided with a cutout area at the end of the message frames which permits the switch arm to move outward, tripping the switch, closing the circuit to the frame-actuating solenoid and causing the projector to go into the rewind cycle. It is also possible to add driving and linkage means to move the lens carrier 12 automatically into the open position at the end of the rewind action.

We claim:

1. A strip film magazine for picture carrying projectable films for use with a strip film projector, said magazine comprising in combination:

- a hollow body having two end portions each defining a compartment therein and an intermediate portion in the form of two plane spaced-apart parallel walls joining said two end portions and each including an opening, said walls defining therebetween a guide path for film and said openings being in registry to define a film gate having a light entry and a light exit face, one of said walls including a further opening disposed in registry with sprocket holes of film in said guide path,
- a film supply spool rotatably supported in one of said compartments and a film takeup spool rotatably supported in the other compartment, each of said spools having an extension protruding from the respective compartment through an adjacent body wall portion; and
- a gear secured upon each of the protruding spool portions for coaction with a gear drive of the projector for winding film from one spool upon the other through said guide path.

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